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Cucumber Growing under Glass.

— BY —

A. A. Fabius, F.R.H.S.,

"Redlands Nursery,"
Emsworth,
Hants.

The Chemical Union, Lt

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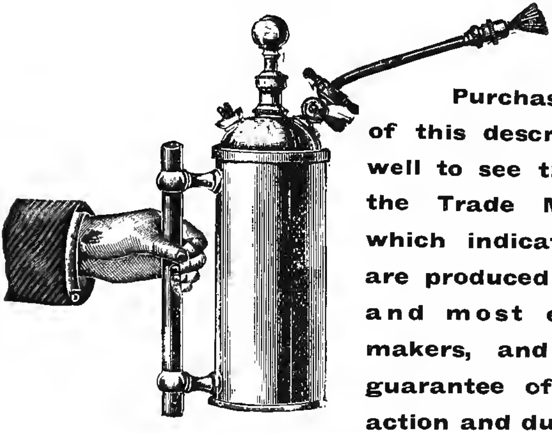

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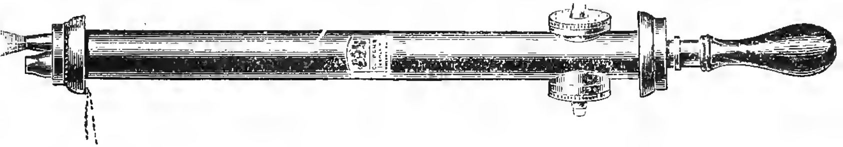

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TABLE OF CONTENTS.

PAGE

PREFACE.

CHAPTER I. .. .. The Sowing of the Cucumber Seed.. 5, 7

CHAPTER II. .. .. Winter and Early Cucumbers.. 8

CHAPTER III... .. .. .. The Soil for Cucumbers.. 9, 12

CHAPTER IV. .. .. The Making of Cucumber Beds.. 13, 14

CHAPTER V. .. .. Planting the Cucumber.. 15

CHAPTER VI. Stopping, Tying, and Training the Cucumber .. 16

CHAPTER VII. .. Cucumber Growing in Shaded Houses.. 17, 18

CHAPTER VIII. .. .. Ventilation.. 19

CHAPTER IX. .. .. The Watering.. 20, 21

CHAPTER X. .. .. Damping Down.. 22

CHAPTER XI. .. .. Top Dressing.. 23, 24

CHAPTER XII. .. .. ..The Use of Liquid Manure.. 25

CHAPTER XIII... .. .. Insect Pests.. 26, 29

CHAPTER XIV. .. Vaporising with Nicotine Compound.. 30

CHAPTER XV. The Express System of Cucumber Growing.. 31

CHAPTER XVI. .. Burning Sulphur and Sulphur Vaporising.. 32

CHAPTER XVII. .. .. .. Ideal Cucumber Houses.. 33

CHAPTER XVIII.. .. ..Seed Cucumbers.. 34, 35

CHAPTER XIX. .. The Age and Vitality of Cucumber Seed.. 36, 38

CHAPTER XX... Thinning of the Fruit and of the Shoots.. 39

CHAPTER XXI. .. .. The Succession of Cropping.. 40, 41

CHAPTER XXII. .. .. .. Summer Cucumbers.. 42, 43

CHAPTER XXIII. Cucumbers in conjunction with other Crops.. 44, 45

CHAPTER XXIV. .. .. Boilers, Firing, &c... 46

CHAPTER XXV. General Remarks—Letter and Reprint from Journal of the R.H.S... 47, 53

APPENDIX, by J. Chidlow 54, 55

INDEX 56, 57

Preface.

IN this little book I propose dealing (as far as I am able) with what are now regarded by market growers as some of the chief conditions of successful cucumber cultivation under glass, and the writer, having devoted many years to the study of this branch of horticulture, hopes that these fruits of his experience, some of which have been gained at a considerable outlay of time and money, may enable others to derive practical benefit from their perusal. Where his methods and treatment differ from the system practised by the reader, he would ask him to give these methods a fair trial on a small scale, say, one house. Yet at the outset I would impress upon my readers that I in no way wish to let this book entirely take the place of practical experience. I am fully convinced in my mind that such a course would result in complete failure.

Much to my regret I have been forced to confine this book to the growing of cucumbers under glass only, though strange to say, my experience in cucumber growing was first gained in large cucumber fields, but I have felt that so many years have passed since I gained that experience, and that it was gained under different conditions and in another climate, that it would not suit the present purpose.

I would impress upon my readers one fact of the most vital importance, that to be a successful cucumber grower, all depends upon the *man;* no amount of advice, instruction, or assistance can be of any use in the absence of that one condition I now refer to as necessary to success. A cucumber grower must study his plants night and day, he must be ever vigilant to supply all their wants, and yet at the same time not to glut them. He must ever have a watchful eye for the first appearance of any insect pest or disease which time after time may arise from unsuitable conditions, from invisible insect pests already in the soil, etc., in a word, the active hand must ever be controlled by the active brain. There is no department in horticulture which requires so much skill and observation, so much practice and experience as does the growing of cucumbers. It is the highest form of intense culture, the quickest process of all known in gardening for transforming the materials of the soil into food for man. No mention is made in this little work of any particular cucumber, the writer having so many friends in the trade, an explanation which he hopes will be well understood.

A.A.F.

Redlands, March 2, 1904.

Cucumber Growing under Glass.

CHAPTER I.

THE SOWING OF THE CUCUMBER SEED.

Cucumbers are the most profitable of all market crops grown under glass. There is certainly no other crop which, practically speaking, takes so little time in maturing, and can return in a few months, such sound profits, yet, on the other hand, it is only possible to obtain the best results by the highest amount of skill. The plants must be treated properly from the beginning, and every attention paid to them.

The cucumber plants should have, from the start, the very best of attention and position. Few of us gardeners can have such greenhouses as we would like them to be, and in a good many cases the existing houses will have to do. The ordinary propagating house is the best place, provided all the plants formerly there can be removed, and the whole place turned inside out as it were.

The way to proceed is as follows. The glass, the woodwork, the walls, everything, must be perfectly clean. Limewash all the walls, the woodwork, and, in addition to this, burn 1 lb. of sulphur as directed in the chapter on "Burning Sulphur," for every 20 feet of run. And it is better to do this twice in succession. The house is then ready for the material to be brought in, the compost, clean thumb pots and moss, which will be all for the present. The best plan is to have a new bench made for the purpose, lined inside with a sheet of galvanized iron, which can be always made clean.

Until the compost is warmed up, the seed growing had better be postponed. The sowing itself is a very simple process. The little pots are filled with compost nearly to the top, with a little moss to take the place of a crock. Make the compost moderately firm, and in this the seed is placed upright, with the point or narrow part downward, ¼-inch deep.

Another method is to sow the seeds in size 48 pots direct, about three inches from the top, gradually filling the pot in afterwards. I have found, however, that when they are placed deep inside the pot they never reap the full benefit of what little sun there is in the dark days of winter. And they cannot be attended to with the best of advantage, such as the sowing in little pots affords.

There is another way still—the sowing in boxes, but this practice has indeed, not much to recommend itself, and the little main root is so likely to be broken off that I should never advise this plan. The only advantage it would give is that the young plant becomes more of a cutting than a seedling, and would fruit quicker, but, on the other hand, it would not last nearly so long. Certainly many hundreds of plants are ruined in this particular way. I admit cucumbers can be raised in this way, and successfully, but this only shows that a skilled gardener will often get good results though his methods may not be the best.

As a last remark about the sowing, I need hardly say that the young cucumber plants should be so placed that they reap all the benefit of a good position near the glass, where the greatest amount of sunshine will reach them.

For the raising of cucumber plants in winter, a house facing south is of great advantage.

I would once more impress upon my readers the enormous advantage that will be gained by starting cucumbers in an absolutely clean house, devoted to cucumbers, and not in the neighbourhood of other plants. Frequently the cucumbers, even when planted out in well-prepared mould, in fresh, clean houses, bring with them from their birthplace, greenfly, thrips, red spider, and often too, nematodes which grow up with the cucumbers and check them more or less, and in fact very often ruin them before the natural period of their lives and the cropping is finished.

I admit greenfly can be easily got rid of by smoking, and so too, thrips or red spider, but not without checking the plants as well. The amount of nicotine required to rid a house successfully of the two last named pests is often more than the cucumber plants will stand during a spell of dull weather or when the plants are cropping very heavily.

Provided then, the cucumbers were started in an absolutely clean house, and the potting mould well sterilized, there is the great probability—the almost entire certainty of raising cucumber plants which at the time they are ready for planting out are *clean*, both as regards the leaves and the roots. I remember quite well planting some years ago, four small houses of early cucumbers. When I had nearly finished planting the last house, I discovered some very minute little growths in the roots. This greatly alarmed me, and I took one of the plants to a good practical gardener living near. He did not think it anything worth troubling about: he thought the plants would grow out of it. To all appearance they did, but only for a little time, and the result was a great loss. When the plants were dug up, they were simply smothered with club. It would have paid me better to have got rid of them at once, even if I should have been unable to plant for another four or six weeks. My experience in growing in general, and most particularly, in cucumbers and tomatoes, has taught me that it is far better to grow plants in one house only, and to do that one house well than to attempt two houses if they can only be done indifferently. Having to clean out one house purposely for cucumbers, and having the house during the first few weeks but partly occupied is a very costly business, but I am fully convinced that it will pay in the end, and that it is the only way to make sure of healthy plants.

Another point of great importance is to start with a far larger number of plants than required ; there is always the probability of having a few plants broken or dying off, and it gives one the opportuntity of planting out the very best only. I take it that every one starting growing cucumbers has already had some practical experience in growing under glass, so that little need be said about the watering. The cucumber seeds should be put in moist soil, but they will need no watering till they have come up, and at all times they should only be watered when they require it, that is, picked over with a toy watering-can having a very small spout at the end. The syringe should be be freely used on bright days. As to the temperature, a good bottom heat of 75 degrees will give good results; too much bottom heat, combined with dry air, will draw the young plants too much. The house temperature should be 75 degrees, with a little fall at night ; 90 degrees in sunshine will not be too high.

As soon as the little plants have filled up the small pots with roots, they are re-potted in 48's If the houses are not likely to be ready for the plants in 48's, it will be better to re-pot in 32's, without quite filling the pots at first, top-dressing them afterwards as required. There is a great deal of harm done in planting too late, to wait till the plants are what is commonly called pot-bound means to spoil them for ever. In Summer we frequently plant out of 60's, and the plants seem to get on much better. In Winter, when every week there is so much extra firing, one cannot afford to plant too soon. Great care must be exercised to keep rats out of the propagating house, both rats and mice are particularly fond of cucumber seeds.

It must be clearly understood that the cucumber plants (while in pots) must be grown, not upon a dry staging, but partly plunged in cocoa-nut fibre, saw-dust, or in any other similar suitable material, which has first been disinfected by a strong solution of copper vitriol. The staging should be raised near to the glass, and lowered afterwards, when the plants become taller. A dry heat will draw up the plants, the houses must therefore be kept moist by damping down.

CHAPTER II.

WINTER AND EARLY CUCUMBERS.

Every page of this book is written from practical experience—years of cucumber growing in all sorts and conditions of houses. And I often think what an amount of money I might have saved, and how many losses in cucumber growing I might have avoided had I possessed at first the knowledge I have since acquired. In Summer there are but very few houses which will not lend themselves to cucumbers, but Winter cucumbers and early cucumbers need a warm soil and temperature. I have practically given up growing early cucumbers; as a matter of fact, the houses here are utterly unsuitable for it. In a season such as the present, 1904, it would mean an absolute failure. To plant cucumbers without warm soil and sufficiently high temperature in Winter or say up till April, is, I am quite convinced of the fact, a loss to the grower. Yet I have had some very good early cucumbers, but only twice out of five years in succession, and one can clearly see that such chance work does not pay the grower who is depending on the crops for his living. Even now, at the time I am writing, I have a little house, a span-roof, 64 ft. long by 14 ft. 6 in., heated by four rows of 4 in. piping, the bed is only three feet wide, and the flow and return run each side. This little house has grown some splendid crops of early cucumbers, both in my time and before: however, this year it looks like a complete failure, with the exception of one or two plants, which, by luck, receive some bottom heat from an out-going return pipe, and so are doing splendidly. To have any success at all with cucumbers the plants must grow vigorously from the start. If they once become stunted they are often utterly incapable of yielding a continuous crop afterwards for any length of time.

The best method which I have as yet seen is the growing of cucumbers for early work in troughs made out of strong boards, placed over the hot-water pipes. For the second crop these boards are removed and stacked up outside. One hears a good deal now of the Priaulx troughs, which I should imagine are even better than boards. Where only a small amount of cucumbers are required, they can be grown on stages; but the great amount of work is rather a drawback. Yet I am quite convinced, by years of experience, that it is far better to go to extra labour and trouble to provide for warm soil or bottom heat, than to plant cucumbers when the bed cannot be kept up to a temperature of at least 70 degrees.

CHAPTER III.

THE SOIL FOR CUCUMBERS.

The best of loam only is good enough for cucumbers. I do not suppose there is another plant which, in such a short space of time, takes so much out of the ground as does the cucumber, provided it is made to grow. But the great drawback is that, whilst one can often afford to use the best of material for pot culture on a small scale, the large quantities required for cucumber growing make it, in many cases, quite impossible to use anything else but what the place offers. In past years I have bought large quantities of turf, which cost me, delivered on the nursery, 2/- per load. But apart from the fact that I sometimes cannot get any worth having, the cost of hundreds of loads, such as I use, is a serious item.

I have come to the conclusion that it pays me best to use the soil on the place, making it good by manure from the stables and by fertilizers. When there has been club in the houses great care should be exercised not to contaminate the ground outside. The one place te which the old discarded soil from the cucumber houses is wheeled should be as far away as possible from the spot from which the new soil is taken for the next crops. It is impossible for me to go into detail how this can best be done; every place has its own difficulties and facilities.

The cucumber soil is really, in one sense, part of the grower's capital, and, provided that all other points are equal, the grower who has, or makes, the best mixture for his cucumbers will have the best crops. A well-managed cucumber plant can bear, practically speaking, no end of cucumbers, but only when the plants are well cared for and looked after from the earliest stages. If we compare the growing of this with that of other crops, we shall find a far greater limit to the out-put in the case of the latter; a cucumber plant will keep on growing and bearing fruit in rapid succession, *pro rato* to the amouut of time, labour and energy spent on it. In making cucumber compost, we have to look at two principal points: first of all, the material condition, and secondly, the chemical value. To the last properties—those of the fertilizer—we can add day by day all that the plants require; but not so to the first. I learnt last year that though the cucumber disease cannot be got rid of when once it has obtained a good footing, yet, on the other hand, I found that in trying to obtain healthy foliage it was impossible to do so when the mechanical conditions were not in perfection.

No matter how rich the ground is, if it is, on the other hand, not *kind*, that is, not sufficiently open to allow warmth and air to enter into it, the cucumber plants will not get on well; yet I have seen cucumbers growing to perfection in heavy soil with hardly any percolation, but the watering was done with such skill and attention that, notwithstanding, the results were more than good.

The worst soil for cucumber growing is that kind of heavy soil which becomes compact and dead. Whenever possible, one should adopt a soil near at hand, naturally adapted for cucumber growing An ideal cucumber soil is the mellow turf from old pasture land, but as difficult to obtain as it is good. If the grower can so manage to have the soil for the following year stacked up and kept perfectly dry for 12 months, it will be freer from all insect pests, an advantage which cannot be over-estimated. It is necessary to keep the soil absolutely dry, and, in consequence, free from weeds, which can easily be done, at very little expense, by covering the same over with corrugated sheets of iron. This will assure the gardener from sad losses as is often the case when insects, such as eelworms, are introduced with the soil into the houses.

If one can but keep the cucumber houses free from club, the same soil, with some fresh added to it, will grow, if need be, two crops in one season. It is not only the cost of labour in wheeling out the old soil, but also the time lost, which in summer is a great consideration. If once the club is introduced into the houses, it will take years before it can be got rid of. When I came to Redlands, some years ago, I lost half of my crops on account of the club, both in the cucumber and tomato houses, and yet I used loads of lime.

It has often been said that the skill of the gardener is the most important factor in gardening, but to look well after sterilization is the great secret of success in cucumber and tomato growing. I doubt very much whether cucumber growing does pay in old houses, but I know for a fact that club in the ground means utter ruin to the grower, unless effectually coped with. No matter what soil is used for the cucumbers, it must be pure. Any soil can be made fertile, but poor soil is better than soil which is not free from fungi or eelworms.

The cheapest way to sterilize soil is to have it stacked up, as mentioned above, with layers of gas lime in between, and to let it remain untouched for a period of twelve months. Another way is to have the soil mixed with fresh horse manure, and lime sprinkled with the soil; this will set the ammonia of the manure free, and will kill all weeds and insect pests. This process has the advantage that it warms the soil, too, which then can be used very soon after.

Although the fertility of the soil is of very great importance, yet, as we have said, the gardener has it in his power to add daily to the food of the plants, particularly so with cucumbers, which receive continual top dressings, besides sprinklings of artificial manures, and liquid manure when watering. A more important question in selecting or making of the cucumber mould is, as we have stated before, the mechanical condition of the soil. The roots of plants must have air to breathe, and particularly in cucumber growing, so well ærated soil is of the greatest importance. Fibrous loams one year old mixed with straw manure from the stables is, generally speaking, in a perfect ærated condition. This is, no doubt, the grower's ideal soil.

In many places where cucumbers are grown, trenches are dug several feet deep at the spot where the new soil is being taken from, and the latter soil is turned over mixed with layers of manure. At Redlands we follow, more or less, the same plan. This Winter I have a long trench dug, 2 feet deep, at the top of the garden, in soil which, so far as my knowledge goes, has never been used for cucumbers before. This border will supply me with suitable mould for a long time to come.

Either horse or cow manure is suitable for our purpose; the latter is excellent for cucumbers, but is of little use in making the soil open. In this district the bracken fern is largely used for stables. It takes years to rot, and makes by far the best of all manures. I also use tons of sand yearly, it only costs me 2/- per load, delivered. Sand itself will not dissolve in water, but it keeps the ground open and warm, and after the soil has been used for cucumbers, it makes excellent potting mould and soil for propagating purposes. Burnt garden refuse and wood should form one of the most important additions to the cucumber compost. Mechanically, their action is towards æration, very much as with sand, and of still greater value are the chemical properties. It contains, more or less, carbonate of potash, which acts upon the nitrates of the soil, making the latter more fertile.

The cucumber will take out of the ground large quantities of mineral matter and potash, in which the burnt garden refuse is at times very rich. On no account, also, must lime be forgotten in our compost, especially if we intend to use the compost for a long time, because lime in the soil plays a part of first importance from the point of view of vegetable alimentation. Upon going over the results of the past few years, I find that the best results were obtained from soils mixed with lime, as a sterilizer and a manure, and basic slag in pure soils. This same compost should also be used for the sowing of the seed, with an additional sprinkling of coarse sand. It will thus be possible to find out, before planting time, if the compost is suitable, and also if eelworm is present. But I take it that this will have been tested long beforehand. I must also state that I have obtained very good results from chemical fertilizers mixed with the soil, but these can only be used to advantage when one possesses some knowledge of the elements of chemistry. As an example, lime and fertilizers should never be used at the same time, because by their union chemical action is set up whereby the ammonia in the fertilizer is set free, and lost to the plant.

CHAPTER IV.

THE MAKING OF CUCUMBER BEDS.

> "Though the primary or top root grows vertically downward, "the secondary roots, which issue from the deep seated layer "called the pericycle, and emerge at right angles to the surface, "are inclined at various angles to the vertical, and do not turn into "the perpendicular direction unless the primary root be cut away. "The object of searching the ground in every direction for moisture "and food is thus secured."—PROF. HENSLOW.

Heavy and continuous crops of cucumbers can only be obtained when the cucumber plants have a large rooting surface. The method of planting cucumbers on small heaps of mould is one which has little to recommend itself. These small mounds of compost have this advantage, however, that they are, in a short space of time, literally one mass of fibrous roots, which are kept in an almost perfect condition, so well ærated does the soil become. But this is the only advantage I can possibly see.

As mentioned above, the heavy and continuous cropping of which cucumbers are capable, can only be obtained when a large rooting surface is supplied. They should have a bed 4 feet wide at least, which is none too large for a plant like the cucumber, that during its whole existence hardly ever ceases forming new shoots and fruit. In fact, the fruiting capacity is in proportion to the length of main or principal roots, extending over the whole surface of the beds, and only when the limit of their growth is reached will the fibrous roots be formed.

Every cucumber plant should have at least 2 good barrow loads of compost, forming a sloping bed about 12 in. deep in the middle. Such a bed can be considered a sound foundation for the cucumber plants, and though by the last method the plant might not come into bearing so quickly, there will be a greater number at once together, and provided that a continuous supply of top dressing, and frequent applications of liquid manure water are given, the supply will continue for a few months certain.

I always like a good layer of long straw litter evenly spread out over the ground that is to form the bed on which the soil is afterwards placed. Clinkers or other such material would certainly help to carry off the water, but it makes the work of cleaning out the soil again for another crop a rather troublesome job.

Better than anything else I find is a layer of sods placed upside down on the long straw litter referred to above, the compost itself then resting on top of the sods.

I once tried keeping the plants in flower pots, but the cucumber does not like to have its roots confined in a narrow space, so I abandoned this method as not giving in any way a sufficient return of profits. Plants placed in boxes resting upon the pipes gave me far better results, but, unfortunately, the plants were clubbing very badly and under those conditions, even with the best of treatment, the cucumber soon gives out.

Any kind of staging will do perfectly well to support the bed, provided it is built on a good solid foundation, capable of bearing the enormous weight of the soil.

Last year I used sheets of corrugated iron resting upon uprights; the first attempt was not a success, the water would not run away freely, and, together with the mistake I made in having the iron and the mould close against the wall, at the back, the soil was kept too wet. I then had some large holes driven in the corrugated iron, with the help of a pointed iron bar, very quick process, and one that answers the purpose very well indeed. The necessary draining was thus assured. and good results followed. But a thin staging such as a lattice-work board or corrugated iron will not do when in close contact with a a very hot flow-pipe, such as I have in several houses here.

One year I had hot beds made in a house 100 feet long, with very good success, but there is much to be urged against this practice from the point of economy and practicability.

Good fresh stable manure for hot beds is difficult to get in quantities, and when it is just in the right condition it will not heat sufficiently for any length of time. But apart from even this, I find there are but few gardeners (that is, in nurseries) who understand the making of such hot beds. Where the manure can be utilized subsequently on the land, or for potting purposes, the hot bed process is worth considering It costs a good amount of labour, but in mid-winter, this is not such a serious consideration. Up till last year, I always planted in my biggest houses two rows of cucumbers down the middle as well as on the sides, but when the last two middle rows of cucumber plants were cleared out, I made up my mind never to plant the middle part of the house again. I found that the two rows referred to made double the work, both in preparing the beds and growing the plants, and though they always did give a ertain amount of fruit, yet they gave practically no return compared with the two sides where the plants were closer to the glass. I can hardly realize now how years ago, when in Yorkshire, I managed to grow four rows of cucumbers in one house, and that notwithstanding the presence of shading on the glass too.

CHAPTER V.

PLANTING THE CUCUMBER.

The only difficulty about the planting of cucumbers is the question of the distance they should be set apart. I have never planted closer than 2 feet apart, and the outside limit was 4 feet.

I think 2½ feet is the most usual practice ; it meets the general requirements of the cucumber. Nothing is gained by planting too close, yet, on the other hand, if the plants are set 3 feet apart it would be a serious loss if one or more of them should die during the season.

The only time I tried planting at 4 feet apart was in two little houses of only 11 ft roof measurement, and they gave, considering their structure, very good results.

If the two-crops-in-one-season system is followed out, little is gained by planting wider than 2 feet or 2½ at the outside. When it is in July that the second crop is being planted, 2 feet from plant to plant is enough space, so late in the season.

If all possible care has been taken in cleaning out the houses, if the plants are strong and healthy, and the soil in the beds all that can be desired, I think I should advise planting 2½ feet apart as a general rule, and not to plant the balls deeper than one inch under the ground. On no account plant in cold soil, and never use plants which are pot bound and ill looking ; it would pay better to plant only 60 good plants in a 100 ft. house than 70, if the last ten plants were but poorly and lacking in vitality.

Provided the houses are ready and the soil sufficiently warm, plant in good time, that is directly the plants are really fit to be turned out of the pots. There is no harm in planting direct from large 60's, but if the houses are not really ready to receive them, re-pot first in large 32's, being guided all the time as we have said, by the state of readiness of the houses.

A few days before planting, the plants, when still in the propagating house should be fumigated to make quite sure that no such pests as green fly, thrips or red spiders are introduced into the cucumber houses, together with them. Even after this every plant should be carefully examined, and a keen eye should look for any trace of the enemy. The plants should be watered a few hours previous to planting, and they will come easily out of the pots. Examine the roots of every plant carefully, it will form an object lesson, and tell us if there is anything wrong with them. If there is a doubt in the planter's mind on any of these points, he had better not proceed with the work, but explain the matter to those in charge.

CHAPTER VI.

STOPPING, TYING, AND TRAINING THE CUCUMBER.

Cucumbers (and the same remark applies to tomatoes) are not worth the growing if they are not attended to from day to day, no matter how good the foundation as to soil, etc.

It has always seemed to me that each grower has his own particular methods of stopping, but I don't think that, provided the stopping is carried on systematically and in good time there is any great difference so far as that is concerned.

The main stem should have at least from fifteen to twenty leaves before the top is pricked out, so as to develop the shoots, but all the low shoots from the bottom up to 18 ins. or 2 feet should be taken away. The fruit on these bottom shoots would not only lie on or touch the ground, but it would not allow a clear space for watering and topdressing the beds. In tall houses it is better still to allow the plants 3 feet clear stem, and not to stop the main stem till the plants are from 5 to 6 feet high.

Those side shoots which will form the cucumber plant proper are pinched off at the second joint from the main stem, and at every two joints afterwards. This plan is a good one to follow out during the whole season of cucumber growing, it will enable the men to have a system to work upon, and to carry out the work with a better understanding. If the pinching and tying of the cucumber plants is carried on day by day, much time will be saved by so doing.

CHAPTER VII.

CUCUMBER GROWING IN SHADED HOUSES.

"The two just uses of all green structures are to elaborate the carbonic "acid gas of the atmosphere into organised substances, and to transpire "water. These are called assimilation and transpiration, and they can only "be done by the means of the rays of light."—PROF. G. HENSLOW.

I have come to the conclusion that the growing of cucumbers under shading is for many reasons entirely a wrong practice, yet for years I used to do so, and cut some good cucumbers too.

Our plan was, during the first two or three months of the year, not to use any shading at all. The first bit of shading was generally put on in a great hurry, when, after days of dull weather the sun came out with an exceptional brilliancy which was more than the cucumber plants could stand. Then a time of perfect misery began; the first coats of shading were not permanent, so that it had to be repeated after heavy rains, then, at last generally on a bright Saturday, when I was afraid I might have to shade the houses, or on a Sunday (a far from pleasant prospect), I had to set to work and shade the lot, but, generally speaking, it was never satisfactary—a very usual experience with shading. To do several thousand feet of glass properly with a brush is out of the question, and the same remark applies to the syringe, no matter how careful one may be, owing to the wind, and then, again, to do shading in between narrow gutters, not large enough to walk upon is a source of great inconvenience. Whitening 4 lbs., 4 gallons of water and one size 60 pot of linseed oil used to be the mixture employed—a very good one indeed.

But then, in the autumn comes the trouble of washing it off, a very costly proceeding if the workman breaks much of the glass.

By far the worst trouble of all was when I found that more than once contrary to my orders, a heavy dose of shading had been injudiciously applied during my absence, such as might have been good for palms, but very injurious to cucumbers, so, in any case, the grower must supervise the operation personally if it is to be done properly.

But I find that cucumbers can be grown, generally speaking, without *any* shading, and not only can be grown successfully, but, to my mind, and in my experience, even much better.

From repeated observation I found that the flagging of cucumbers was due to mismanagement in watering, and since I have paid such great attention to the soil and to the watering, I have not seen much flagging at all in cucumbers.

Where the glass has become very dirty and difficult to clean, I advise washing it with water containing a small quantity of hydrochloric acid ; this can be bought very cheap, and is a most effectual cleanser of glass.

CHAPTER VIII.

VENTILATION.

I have seen cucumbers grown without any air at all, and have done similarly myself in former years, but, for my part, I have now abolished this practice altogether, just as I have dispensed with shading, because it is far from satisfactory in many ways. Judiciously airing the cucumber houses during all seasons when the weather permits it is not only a most decided benefit to the cucumber plants, but equally so to the men who have to work in the houses.

Sudden changes have to be avoided; they are dangerous, and check the plants, and help bring on aphis pests, etc. As a general rule I should advise whenever the temperature reaches, say 90°, a little air to be put on, even early in the year, for a short time. If this is done with necessary care and attention it will benefit the plants. Fresh pure air is as necessary for plants as it is for man.

In the early months of the year especially, ventilating needs a great deal of care and attention. It might be necessary to give air and take it off again several times in one day, when the sun is breaking through the clouds for an hour or two at a time. The difficulty with new methods always is to master and to fully understand them, and, above all, to make the workmen understand them too.

A gardener who has always grown his plants in the one particular way he learned in his youth and after, generally regards his particular method not only as a good way, but as the only way. Such a gardener is not easily persuaded to try fresh methods. And when a man has always been accustomed to growing cucumbers under a shaded roof with the house kept closed, it will seem to him, at first, something like folly to apply such different methods. "Did I not have some fine cucumbers? why, we cut so many hundred dozens out of such and such a house." One often hears this and similar things said as a reason for not departing from stereotyped methods.

At the same time the houses should be kept at one uniform temperature, and sudden changes must be avoided at all costs, for they will utterly ruin both the plants and the fruit, causing the latter to grow crooked as well.

Small stones or anything similar, suspended from the bottom end of growing cucumbers by a piece of raffia, will usually keep the fruit from curling up, but they are unnecessary, providing proper attention is given to ventilation and watering.

CHAPTER IX.

THE WATERING.

Watering is the most difficult of all garden operations, and can only be learned after years of practice. Often, to all appearances, the compost will be quite moist, in fact wet, yet, underneath, it might be hopelessly dry.

A good rule in watering, which at all times can be followed out is, never to give the plants any water till it is found they need it. Should there be any doubt, the watering should be postponed.

During the first few weeks the ground can be duly examined around the plants, and the state of the soil ascertained. When once, however, the roots have covered the bed, then is the time that judgment is required.

During the first few weeks the soil should remain in a semi-dry condition so ideal to the formation of roots, for they, it is, which will take up the food (the capital invested) out of the soil, and turn it into cucumbers. Thousands upon thousands of little mouths should be busy under the ground, feeding upon the food which is there before them. On no account make the ground unfit for habitation, sour, pasty, inpenetrable by heat and moisture, or unfit for nutrification.

When once every portion of soil on the surface of the bed is threaded with roots, and the cucumbers are hanging down in great numbers, the plants will need large quantities of water. The amount of cucumbers cut. day by day, should, in some way, be taken as a guide. There will be, under good management, weeks of heavy cutting; plenty of water then will help the fruit to swell to a good size.

WATERING MAXIMS.

Keep the surface soil at all times perfectly open and friable.

Abstain from watering rather than risk giving too much.

When watering be sure that the whole bed is penetrated to the very bottom, not wet on top and dry underneath.

Remember that to water under conditions favourable to success demands, first of all, a soil of suitable physical texture, as described under "Soil."

The application of water tends to lower the soil temperature considerably, bear this in mind with reference to time of watering, which should, preferably, be early in the day to check this effect as far as possible. Avoid giving checks to the plants, *e.g.*, cold water from the main in hot sunshine, etc.

The water should be, as nearly as possible, of the same temperature as the house, Water *thoroughly* a *few* times, rather than giving a frequent *sprinkling*, which only tends to cake the surface, and never reaches the myriads of roots beneath.

Cucumber culture is not a mere matter of routine at fixed intervals, like the winding of a clock; it is governed entirely by the circumstances, soil, sunshine, time of day, season of year, condition of the plants, &c. Good plants cannot be grown in a continually soppy, heavy soil.

A waterlogged soil (especially when the latter is richer than usual) frequently produces chanking of the fruit, and thus often helps destroy a large part of the crop.

Lastly—think first; water afterwards.

CHAPTER X.

DAMPING DOWN.

The heat arising from the pipes is rather uncongenial to the welfare of the cucumber plants as regards the foliage, etc., and the grower remedies this this by damping down the path, steaming the pipes, or syringing.

In the early stages of their growth, syringing will greatly assist the plants and help to keep them free from insect pests.

Until the cucumber plants have started bearing fruit, provided the warmth is kept up in the houses, this damping down can be done several times during the morning and noon, and towards night, provided always that the sun coming out in the morning does not find water on the leaves. Healthy plants with healthy foliage will suffer little from sun burning.

Steaming the pipes as it is called, *i.e.*, sprinkling the hot pipe and thus producing steam is another useful practice which will moisten the atmosphere and increase the temperature of the house for the time being.

This damping down, syringing and steaming will counteract the day heat of greenhouses, and will materially assist in keeping back aphis, red spider and thrips, but on no account must the syringing and damping down be overdone when the temperature of the house may be brought too low thereby, say to below 60° ; nor again when it is intended to fumigate the cucumber house, which then should be kept perfectly dry. During very hot and sunny weather, in summer, I take it that the damping of the walls and paths, not of the *foliage*, of course, is as essential as the watering itself. It will, when done properly, keep the temperature of the house several degrees lower than it otherwise would be.

After heavy cropping of cucumbers the plants have lost much of their vigour, and the new leaves are much smaller and thinner, so we must now be most careful not to have the house too close or too damp, as this will certainly bring on mildew. The floor and paths should be sprinkled at shutting-up time with diluted manure water giving off a smell of ammonia, which is very much liked by the plants. As a preventative against the cucumber blotch disease it is recommended by Mr. G. Massee to spray every portion of earth in the house with Bordeaux mixture once a week from the first, even if there is no evidence of the disease being present.

Damping down should be carefully avoided after mid-day, when it is found that, owing to low temperature, the leaves are wet in the morning. In such a case it would be most unsuitable to the welfare of the young cucumber plants.

CHAPTER XI.

TOPDRESSING.

"Out of nothing, nothing can come."

If the cucumber plants started with a proper amount of soil—about two barrow loads for each plant—levelled down to form a continuous bed, no topdressing will be necessary, until it is found that the main roots have reached their limits which will be about the time the plants show a splendid crop of fruit. Then is the time that a thin layer of fresh soil, just enough to cover the bed, and no thicker, will benefit the plants.

Such a topdressing will do more good than a thin sprinkling of artificial manure, but the latter dressing has the advantage of being applied in a very much shorter space of time. Now we all know how hard pressed for time we growers sometimes are, and the greatest pressure comes, as a natural consequence, just when so much time is taken up with the cutting and packing of the cucumbers.

My advice is, on no account spare labour in cucumber growing unless it can really be avoided ; it is the worst form of economy, one of which we all are guilty at times, more or less.

During the whole of the period of cucumber growing, the aim must ever be the production of new roots. It is not simply sufficient to supply food for the plants in solid and liquid form during their growth. New applications of soil must be made from time to time, in the form of top dressings, which quicken root action wonderfully.

Of course, in this work, again, the grower must be guided by the actual wants of the plants, no top dressing is needed until the bed is one mass of roots on the surface.

The Cucumber plant is the most generous, hard working and prolific of all garden plants under glass with which I am acquainted, giving a hundredfold in return for what it receives, and paying the gardener in fruit exactly proportionate to the amount of care and attention he has bestowed upon it. To quote the maxim with which this chapter commences, "Out of nothing, nothing can come," which is a saying that should be ever in the mind of the gardener.

The rapid and wonderful manner in which the cucumber plant of our hothouses, when properly heated bears fruit, must ever be remembered. The cucumber plant can very well be compared with the engine of an express train, the better it is fed the faster it will go.

It can thus easily be seen that as soon as the cucumber plant gives back results in the shape of fruit, some part of the nutriment contained in the cucumber bed has been taken away, and that the food supply to the cucumber plants must be replenished, and so kept up to the necessary requirements.

Before going to the expense of buying artificial manures, the grower should, first of all, make use of such materials as are at his command, or as can be obtained at moderate prices.

To every topdressing a liberal sprinkling of lime must be added, which not only will give fruit in abundance, but particularly good in flavour. It is commonly supposed that the bitter cucumbers are the result of a lack of water, but I am firmly convinced that this is not so. For my own eating I prefer the small cucumbers, they have by far the best flavour, but as is always the case, the public will have size before everything.

CHAPTER XII.

THE USE OF LIQUID MANURE.

Plain water is but a poor diet for the hungry cucumber plants, if they are to be expected to afford no less than three cuttings of fruit every week during the full season, consequently the most important work of the cucumber grower is the feeding of his plants with liquid manure by which he chiefly supplies the material for the building up of new shoots and foliage, and also obtains those large sized cucumbers of the gun-barrel type, which find so much favour in the eyes of the public.

A large cucumber will, as we all know, bring in more hard cash to the grower than many little fruit. And yet, strange to say, the last have taken more value out of the ground, in the form of minerals, acids, etc., whilst the large fruit is built up principally from nitrogen and water.

I have found that the quickest method of making the fruit swell is by employing nitrate of ammonia, and I strongly advise the use of it, also small quantities of nitrate of potash, when the plants are loaded with fruit. If at this stage the grower neglected his plants in any way, they would take a considerable length of time before they all would properly develop.

The way in which we use liquid manure from the stables, etc., is by having a few cansful brought into the house and dipped in the water tank, making a very weak solution suitable for frequent applications. When the supply runs short, the manure is first soaked in a tub to supply the liquid solution, or it is tied up in bags and dipped in the tanks, one for each house, so as to make, in either case, a weak solution. Occasionally, also, soot is used, about one bushel to a thousand gallons of water.

Towards the end of the season, if I find that the soil is getting too cloggy and unkind, as sometimes happens, I use a very weak solution of carbonate of potash in the water, which generally gives good results.

* * *

CHAPTER XIII.

INSECT PESTS.

"Prevention is better than cure."

Success in cucumber growing can never be reckoned on unless the work in all the details is carried out properly. Cucumber growing in newly erected houses is practically speaking very easy, because, to begin with, no cucumber enemies are to be found in such houses, as a rule, and care should be taken never to allow them to get a foothold. The clubbing of the cucumber roots is unfortunately one of the pests which I have had to battle with for years.

It is, like the cucumber blotch disease, one of the most dreadful plagues in fruit-houses to be overcome by the gardener. The houses at Redlands were, on this account, when I first came here, completely useless for cucumber and tomato growing; not even half a crop could be relied upon.

The clubbing of the cucumber roots is caused by a microscopic worm, called Nematodes. In Nicholson's Dictionary of Gardening, under the heading of Nemotoid Worms a very interesting article will be found, of which we quote the following, bearing directly upon our subject:—

"Not less dangerous than the above are the Nematodes that gall the roots of plants. The swellings usually are to be seen on the root tips, though often they occur higher up the roots. They vary greatly in size, from little larger than a pin's head on fine roots to the size of a hazel nut, or even larger."

My practical experience of many years is that they appear in the houses in a truly marvellous way, and remain in the soil, alive, months after the crops have been cleared, though they are generally much less in evidence in the spring crops than in the second or summer crop. The actual harm to the cucumber plants is twofold; they stop, more or less, the circulation of the sap in the first place, and secondly they make the cucumber liable to the attack of fungus parasites and insect pests.

When cucumber plants are found to be attached by the club, they should receive weekly topdressings which, to some extent, for a little time, remain free from the pest, and supply the new little roots with uncontaminated food soil.

But, generally speaking, the club must at once be effectively dealt with, even at great sacrifices. Every particle of the soil of the old cucumber beds must be cleaned out, removing it carefully to a safe place outside, where it can be buried under gas lime, several inches deep. Of all the remedies I have tried, gas lime is the cheapest, and it is as effectual as carbolic acid.

After the soil has been removed out of the house and treated with lime, the barrows and tools should be washed with carbolic acid, and the men should see that they do not carry any of the old soil into the other houses.

Next, the house itself should be treated with sifted gas lime. Every inch of surface must be dealt with, and the lime well worked in; and after this the hose should drench the ground thoroughly. I now use boiling water direct from the water pipes, which are, for the time being, connected with the main of the Portsmouth waterworks. In this way I clean the woodwork, glass and brickwork at the same time.

The operation should be done before the end of autumn (not in the spring), thus giving the gas lime a much longer period in which to kill the eelworms, and, even then, it is much better to grow the first crop of cucumbers on benches or in troughs.

I believe that it is only in this way the grower can cope successfully with this insect pest. Another serious pest is the common woodlouse, Armadilla Vulgaris. It hides everywhere, in all sorts of crevices, having a natural antipathy to the light, and it frequently eats away round the stem of the cucumber plant, just below the surface of the ground. One is apt to think, at first, that woodlice do but little harm, only eating bits of refuse, &c. But unless an onslaught is made upon them in dead earnest, and kept up until they are absolutely eradicated, they will gradually destroy what may be regarded as the capital of the gardener. To trap just a few, here and there, is of no imaginable use it is simply waste of time; they must be cleared out in their entirety if at all, to do any good. They are easily trapped in flower pots, etc. filled with short hay, and we have collected buckets full in that way. I once tried the experiment of letting some fowls run loose in some empty houses, thinking they would clean them all out, but without good results. Soot and lime was another remedy tried, but it was by no means satisfactory.

Another insect which at times does serious harm to the stems of the cucumbers is the wireworm. In the harm it does it greatly resembles the woodlouse, and it is very difficult to get rid of, the only remedy I know is to have them all collected and destroyed. Red Spider (Tetranychus telarius) is in spite of its name neither a spider nor an insect, but it is really one of the spinning mites. The best remedies against these mites are the vaporising of sulphur, damping down, a moist atmosphere, and syringing with strong soap suds, or with Gishurst Compound (1 or 2 oz. to 1 gallon of rain water), but only when there are as yet no fruit.

Thrips (Thrips Minutissima). This little insect can often be found on potato plants, it is as small as it is troublesome. They pierce the leaves with their beaks to suck the juices. Water is inimical to them, but they can hardly be dislodged by it after obtaining a firm footing; fumigating with nicotine compound gives the best results; but only when it is carried out on successive evenings.

Green Fly (Rophallosiphon Dianthi) can easily be got rid of by fumigating. The black green fly (Aphis rumicis) which generally enters the houses in late autumn is much more difficult to get rid of.

The cucumber leaf blotch disease (Cercospora Melonis) is so well known to all growers that it needs no description here. How many hours of anxious thought has this disease, alone, cost many hundreds of gardeners, and how many crops have been ruined by it? All gardeners must feel themselves more than indebted to that eminent vegetable pathologist Mr. George Massee for the pains he has taken in finding a cure for this dreadful disease. His paper upon a "Method of rendering Cucumber and Tomato plants immune against Fungus Parasites" on page 142, vol. XXIII of the Journal of the Royal Horticultultural Society should be in the hands of all. I am treating all my Cucumber and Tomato plants in accordance with the directions there given, and I would strongly urge upon my readers to do the same.

Such a serious disease as the one now under consideration must be guarded against, in every possible way, and though it may have been absent from a nursery for a considerable length of time, that is no reason for feeling secure against its reappearance, at any time.

I have visited numbers of places and seen the numerous remedies employed, but I have always found that, once the disease has secured anything like a good foothold, nothing will save the plants; no matter what the remedy is it must be applied in time. See, also, in this connection page 184 of the Gardeners' Chronicle for Sept. 5th, 1903, where several points relating to the cucumber disease are dealt with by the same author. The practical directions for treatment given by Mr. Massee are as follows:—

"Commence watering cucumbers and tomatoes when a fortnight old every third day with a solution consisting of one ounce of sulphate of copper dissolved in 50 gallons of water. After treating for six weeks' as above, commence watering every fourth day with a solution containing one ounce of sulphate of copper in 35 gallons of water. The sulphate of copper should be pure, and rain water should be used, if possible."

There is, however, no doubt left in my mind, that rational cucumber growing such as I am trying to describe in these pages will not only give higher profits to the grower, but will also at the same time make the plants better capable of withstanding the attack of parasites.

The mildew of cucumbers (Erysiphe cichoracearum) is very easily checked by using the sulphur vaporizer, but it is, however, a certain indication of unfavourable conditions, especially bad ventilation combined with low temperature. This mildew is a microscopic fungus.

CHAPTER XIV.

VAPORISING WITH NICOTINE COMPOUND.

One of the reasons why cucumber growing in old houses, out of good repair, is often so unprofitable to the grower can be found in the fact that in such houses it is difficult to keep up a continuous temperature sufficiently high, during cold weather, with the consequence that the plants receive a check. This is especially the case during summer, in unheated houses. Badly glazed houses do not keep their temperature during the night, and the plants suffer in consequence. A bad attack of aphis is quickly brought on, and the usual means of vaporising are of but little avail when the fumes are carried away but too quickly through the many openings in the roof.

In such houses liquid Insecticide, of which I do not know one which can take the place of nicotine compound, is the most reliable to use, but the use of nicotine compound in this form is very unpleasant indeed, even though I have known gardeners upon whom it had not the least effect. At one time I used the compound largely as a wash, but the smell made me so ill afterwards, that personally I would not use it on any account.

Fumigating the houses with the nicotine compound is quite harmless in every way, both to the plants as well as to the operators. During this process a good deal of nicotine might be wasted by having the wick of the methylated spirit lamp too high up, for, although the nicotine should evaporate rapidly and evenly in the cup (or cups if more than one lamp is used) yet, at the same time, if the flame is too high, much of the nicotine will be used ineffectively.

CHAPTER XV.

THE EXPRESS SYSTEM OF CUCUMBER GROWING.

The express system of cucumber growing means, in effect, limiting the duration of one particular crop to a definite period of weeks or months, so as to grow in the same house a second crop of cucumbers or a crop of tomatoes, whichever the grower may desire. There is much in favour of this system, the only real drawback is that after the first crop in any one house is finished, which would usually occur in the height of the cucumber season, a period of at least six weeks would elapse before we began to get a fresh supply of fruit from the new crop being raised there. Still, I think this method of growing pays best in the long run, particularly when we are raising crops in several houses simultaneously, for in this case, by having the first planting done a few weeks earlier in some of the houses than in the others, we are enabled to get a continuous supply of cucumbers all the time. Where tomatoes and cucumbers are both grown in large quantities they can be very profitably made to follow in succession, alternately as it were. This year I have planted four early houses with tomatoes, these I intend replanting at about the end of May or beginning of June, with cucumbers. But, as a general rule, tomatoes follow cucumbers in the same house very well, and better than vice versa, because they do so well in the old cucumber beds, so from choice I should generally follow this practice. After July, when the outdoor cucumbers commence, the price of cucumbers falls considerably, though not too low for profit as a rule, and of course there is always a chance of the outdoor cucumbers being a failure, but with a warm and dry autumn both cucumbers and tomatoes drop down very considerably in price.

Remember that a small supply of either can always be disposed of at much higher prices than can larger quantities, and if it is the case of a local supply to shops, then I should certainly follow the plan above outlined for securing a continuous supply. Tomatoes following cucumbers is certainly the more economical practice, for these reasons—that the old cucumber soil is already there, waiting for the tomatoes, while the tomato plants can be grown on outside until quite large plants, before being taken in. In some years I have raised several hundreds of tomato plants in this way, growing them on outside and then potting into 24's and 16's when they were bearing several trusses of flowers, so that finally, when brought in, a very little time was wasted before the second crop began. When it is decided to re-plant the cucumber houses with either cucumbers or tomatoes, the cucumber plants still there can be hurried on, as it were, during the last few weeks to finish the fruiting as early as possible, keeping the houses much warmer and admitting less air, by which means the remaining fruit will swell and mature more rapidly. Immediately before throwing away the old plants it is highly desirable to fumigate thoroughly with burning sulphur. Further information on this point will be found in the article on Burning Sulphur.

CHAPTER XVI.

BURNING SULPHUR AND SULPHUR VAPORISING.

After the completion of every crop and before the old plants are taken out of the house, and again before a new season's crop is planted, each house should be smoked out with burning sulphur, in the proportion of 1 lb. of sulphur to every 1000 feet of cubical contents. A few old iron pots are the best for this purpose, though flower pots can be made use of equally as well. Three pots of sulphur (or more in the case of very large houses) are employed, placing one in the middle of the house and one at each end, the sulphur being dropped in and lighted by placing a red-hot cinder on the top. The doors and ventilators must all be kept perfectly closed during this process, not only to prevent the sulphur fumes from escaping, whereby they would fail to do their work effectually, but also to prevent the fumes from being carried into other adjacent houses and so damaging any plants, either there or outside, with which they might come in contact. As an example of what I mean, I once saw some large poplars with their leaves completely burned by sulphur vapour escaping from a house, although the latter was several yards from the trees so affected. The method of sulphur vaporising, a proceeding entirely distinct from sulphur burning, with which we have just dealt, must now be referred to. For years I have used a home-made sulphur vaporiser, such as is mentioned in "Bailey's Forcing Book." Last year I bought one of Campbell's Patent Sulphur Vaporisers, and well pleased am I with it. No indoor gardener can possibly do without this vaporiser. The only plants which, in my experience, will not stand the sulphur are Maidenhairs. I find it is best to dispense with the outer flanged cup, for, by so doing, the process is considerably quickened. It should be used immediately any sign of mildew or of the cucumber spot disease is noticed in the houses. There is no harm in doing it at frequent intervals, and the cost is very small, but in the absence of proper care there is always a great danger attached to this process, and once I had a whole vinery in fruit absolutely spoiled, the sulphur having got alight, which I failed to notice until too late.

CHAPTER XVII.

IDEAL CUCUMBER HOUSES.

Generally speaking, those houses where the cucumber roots have the free run of the floor space are the best houses for summer crops, for when they have plenty of scope it is surprising what the plants can do. The heaviest crop of cucumbers I ever had was in a house 27 ft. wide by 100 ft. long. Here I cut four crops in succession, the first 120 dozen cucumbers were cut in ten days, and in all the total of cucumbers cut was 800 dozen. The original beds were four feet wide, and they were top dressed five times from April 24th till July 24th. On May 14th, stable manure was wheeled into the house and spread over the whole length of it. In addition to this, I also used one bag of Special Cucumber Fertilizer, from the Chemical Union, Ltd., of Ipswich, and I attribute the success of this crop largely to the use of this Fertilizer. When they were dug up in September, it was found that the roots had extended as much as five feet outside the original bed. The next best results were obtained from houses 14 feet wide, where the roots have the whole play of the floor space, though the paths are as hard as iron but are mulched over with long manure. In four other houses, where the roots have, practically speaking, unlimited space, they travel right underneath the hot water pipes into the soil under the path.

These facts will show plainly that for summer crops the large bed system is the best, and that therefore, naturally, from early crops which are grown in troughs or on staging, the crop can never be expected to be as good or as large. It is utterly useless starting early cucumbers without warm oil. The roots of cucumbers must have in winter a soil of a temperature of not less than 70 degrees. They stand practically still at a temperature not exceeding 60 deg. Over and over again I have examined cucumber roots which had been planted early in the year, and found them, without exception, devoid of the original tap root.

* * *

CHAPTER XVIII.

SEED CUCUMBERS.

Every grower of cucumbers should save his own seed, and one of his smallest houses should be set apart for this purpose. One can easily partition off one of the houses, and make one of the compartments into the cucumber seed house. To save cucumbers for seed in any other way, here and there, gives but poor results, because (1) They spoil the fruiting plants. (2) The seed cucumbers will be required to remain on the plants long after the general crop is finished. (3) The seed cucumber plants require a different treatment. Besides these reasons I would mention several others. The growing of cucumber seed requires an immense amount of care and unless they are looked after and given every attention the result will be entirely haphazard. Of course there is always a chance of finding among hundreds of fruiting plants some plants better than others, and it will pay the grower to look for these, also to devote such plants entirely for seed purposes. Apart from this, I much prefer to have seeds from plants grown specially for this purpose and to use a rather poor sandy soil with plenty of burnt mould, making a very sparing use of manures and fertilizers, in fact, to grow the plants under the most natural conditions as far as possible. They should be grown without shading and given plenty of air, if necessary the ventilators can be made insect proof by perforated zinc or such material, and as the cost is, practically speaking, very small it will certainly pay to do so. The bottom shoots in the case of seed cucumbers are often left on. Some seed cucumbers are of enormous weight, and they would benefit by lying on the ground, rather than hanging down and thus straining the shoots and the wires.

If a sparing use of manures and fertilizers has been made, and the soil used one of a rather poor nature, there will be an abundance of small flowers suitable for our purpose. To pollinate the cucumbers pick off the male flowers, remove their corollas and apply the now exposed anthers to the stigmas of the female blossoms.

When the fruit is quite set, the plante should be well cared for in the matter of foodstuff. On no account must these plants be neglected, the result would be but partly developed fruit, so the plants must be kept growing as long as possible, and the fruit left on the plants as long as they will remain there and until the latter are almost dead. Particular care must be taken to keep rats and mice away from cucumber seeds, they will try to get into the houses, if not by the bottom then by the top, in order to attack the cucumbers A good place for storing seed cucumbers is a suspended shelf in one of the houses, where they should remain carefully numbered and labelled, and too much care in this matter cannot be exercised in view of the subsequent confusion of different kinds thus avoided.

The seed will be ready for taking when the cucumber is quite soft; then the cucumber is cut lengthways into four pieces, without, however, cutting the seeds, and with a small spoon the seeds are carefully collected and placed in a clean bucket. Along with the seeds, the cucumber pulp must be collected, and a good way to separate the two is to rub the seeds together in finely sifted sand, doing so several times until the pulp is removed. The sand and pulp will then pass away through a fine sieve, the operator holding the same under a stream of water till nothing but the pure seed remains, which is afterwards dried and stored away. Those seeds which float freely on the surface of the water are of no use and must be discarded, keeping only such as sink to the bottom when immersed. I lay the seed out on tissue paper and, as far as possible, dry it in the sun, in one of the spare houses, and then collect the seed in glass jars or tins. I think the sun has a great influence in the ripening of the seeds.

The greatest trouble and care must be exercised to have the different kinds labelled in such a way that it will be impossible for them to get mixed up, and it would never do to trust to memory alone. They must always be labelled carefully at the time.

CHAPTER XIX.

THE AGE AND VITALITY OF CUCUMBER SEED.

When I go back in thought to the days of my earliest experiences in cucumber and melon growing, the one fact, which above all others has made the greatest impression on my memory was the importance then attached to the age of all seeds employed. In the establishment where I was an apprentice all the packets of cucumber, melon, gherkin and cantaloupes seeds were carefully labelled with the dates on which they were gathered, and no seeds less than three years old were ever employed for raising plants

All the plants we grew were raised in frames out-of-doors. The seeds were placed three together, wrapped up in tiny balls of moss, well moistened and sown in hot beds at a depth of ½ inch, with the soil above pressed down firm. Pots were never employed in this system of culture, and the balls of moss were found very helpful in bringing the tiny rootlets into closer contact with the particles of soil, and every fortnight the growing plants, from the earliest stages onward were transplanted into fresh beds. We were always given to understand that plants grown from seed that was less than three years old would produce little fruit compared with older seeds. Consequently, in after years when I turned my attention to fruit growing under glass, I was very much surprised at first to find that but little or no attention was paid to the age of the seeds, and I began to speculate how far the first methods described might be the right ones.

If, indeed, it held good that seeds three years old were intrinsically superior to the younger ones the difficulty often was to procure a sufficient quantity of the same variety of ascertained age. On this account I had no opportunity of growing new and old seeds of the same variety side by side and the general question of how far and in what way one seed might be superior to another, either owing to difference in age or to intrinsic superiority of some seeds over others of the *same* age, remained undecided in my mind until the early part of 1902, when I adopted the plan of sterilizing cucumber, tomato and other seeds. This was done in order to protect them against fungus parasites and I employed for the purpose Corrosive sublimate (Hydrarg perchlor). The result of using this remedy was at once apparent, in that many of the seeds never came up at all, especially so in the case of cucumber seeds. Seeing that all the seeds were treated in the same way, *i.e.*, soaked in a solution of 1 part in 8,000 of water, it seemed strange for some to lose their vitality in consequence while others remained immune.

My next experiment was that of selecting the plump seeds, only to discover whether they might not all of them withstand the destructive effect of the sublimate treatment, but the result was similar. A proportion of the seeds perished, though not so many perhaps as in the former case. Thus it followed that sterilizing the seeds in this way was disadvantageous, so far, in preventing many of them from germinating at all, but, when the remaining ones that had survived the treatment, were grown on and brought into bearing the plants were remarkable for their fecundity, the quantity of fruit as compared with ordinary crops raised from seeds not so treated was phenomenal.

The practical deductions from the above observations I take to be as follows :—The solution of Corrosive Sublimate appears to exercise a selective action upon the seeds soaked in it ; those seeds which from inherent inferiority, inferior development of structure, or insufficient storage of nutritious matter are least likely to make good strong plants, seem, for the same or similar reasons, to succumb to its action. The seeds which survive, on the other hand, are most probably those possessing the greatest inherent vitality, the greatest resisting power, and in their case, at any rate the sublimate in no way seems to act to the detriment of the resulting crop.

The reader will understand that these results were quite unforeseen when this method was first employed, the object then in view was to sterilize the seeds in a general way to render them immune against disease.

When following out this practice of sterilization it is seen to be advisable to sow a number of seeds in excess of what will actually be required, so as to allow for the elimination of the weakly ones, as above mentioned.

Taking into account the various facts I have mentioned and also from my general impression, I am convinced that the greatest care should be employed in harvesting the new seed. Time must be allowed for the fruit to ripen, which, as I have explained, should be laid out on a shelf out of reach of insects, and the cutting of the fruit should not be begun till the fruit shows signs of decaying The seeds should be gathered in pails and remain in their juice for some time, not being washed clean till after some fermentation has taken place, otherwise immature seeds will be the result. In washing out the seeds those remaining floating on the water, and which do not immediately sink to the bottom, should be rigorously discarded as being of no use. I have done this not on a small scale but on a very large scale during weeks of cucumber seed harvesting, testing the seeds afterwards.

Though I cannot explain why it is so, I fully believe that the cucumber seeds require a period of rest, that a change must take place during this period I am fully convinced. and this recalls the fact that some seeds of roses will germinate better the second year than the first year. On the other hand I know that one year old seed is capable of producing good crops, for I have raised cucumber plants from seeds about three months old, and the plants, on the occasion I have in mind, bore fruit in the proportion of 89 to every 100 of leaves.

CHAPTER XX.

THINNING OF THE FRUIT AND OF THE SHOOTS.

If good size cucumbers are required and the plants are expected to bear some dozens of cucumbers each, they must not be brought to bear too soon, but plenty of time must be allowed for them to build up a strong frame. On no account should any fruit remain on the main stem, and when the fruit appears in clusters, as with some varieties, each cluster should be reduced to one. If too many fruit are allowed to remain on the plant the grower will have to pay a very heavy penalty, the fruit will start chanking. Chanking is generally understood as being caused by a fungus, but I am quite convinced in my mind that overcropping the plants in the first stages is almost sure to bring on chanking of the fruit and so will a water-logged soil. As a rough guide I should advise the grower never to allow any shoots on the main stem below 2 feet from the ground, and on no account more than two main shoots for every 12 inches of stem, nor to allow more than one fruit on each main shoot. This, for ordinary houses, will give no less than two dozen good sound fruit per plant, and each fruit will have not less than two leaves to help to bring it on. If this rule is followed out during the season of growing, it is possible with healthy plants to obtain not less than 5 dozen fruit at an average on each plant, and it is possible to grow plants producing twice that number. I always count upon 50% profit in cucumber growing. I am quite sure the grower who has not got the courage to thin out his fruit will never reap the full benefit from his labour. If the plants are cropping well, that is, producing one fruit to every shoot of two leaves, it is much the quickest process to limit the number of shoots, only allowing each main shoot to form one side shoot. No greater mistake can be made than crowding the shoots. solitary leaf is not of much use to the plant unless it reaps the full benefit of the light.

The cucumbers should be cut as soon as they are ready, much harm is done by allowing the fruit to remain on the plants too long. I should also mention that to prevent the possibility of the fruit becoming fertilized, all male flowers should be carefully removed every time the plants are being tied and stopped.

CHAPTER XXI.

THE SUCCESSION OF CROPPING.

There is a great difference in the way that some varieties of cucumbers produce fruit as compared with other kinds. Some varieties will crop continuously though at no time very heavily, whilst others are only cropping at intervals, and again there is much difference in the way that different individual plants of the same variety will crop at different times. The houses which are planted late in Spring must be kept going until the Autumn, or so long as they can possibly be made to do so. Very much depends upon the system of managing, and it is here, I think, that the greatest skill in this respect is required. If such houses are well managed and kept bearing fruit until October, it is surprising what a large number of fruit can be cut in this way, though for the last few weeks the number of fruit falls off considerably, and the general appearance of the plant is poor, Whenever such Cucumber plants fail to break freely (*i.e.* to form new shoots), and yet the roots are, at the same time, in a good, healthy condition, I have found it advisable to cut back part of the bed shoots, using a liberal sprinkling of superphosphate, just before the top-dressing, and on no account must we omit the liquid manure water, which is most excellent for producing the effect desired. After the first heavy crop of fruit has been cut and also more or less after every heavy crop of fruit, the soil should be allowed to become semi-dry, that is, moist without being wet, and when the plants commence again to form fresh shoots ("break") they should be top dressed. If this top-dressing is overdone (*i.e.*, applied say at shorter intervals than once every fortnight), there is the great probability that there will be, as the result, too much foliage, without a due proportion of fruit, as we noticed was the case, also, with liquid manure.

The cucumber grower should always study most carefully the effects both of the top-dressing and of the liquid manure to regulate them accordingly, this remark applies, also, to the use of the many chemical fertilizers now on the market. Again, with regard to the value of any particular soil available for use as the basis of the cucumber compost, one can easily judge, after using a soil for one season, whether more soil, of a like nature, from the same source, is likely to be suitable for the next season's crops; in all such cases actual experience is the best guide; no amount of information can compensate for or prevent losses arising from an imperfect acquaintance with the local conditions, such as value of soil in any particular locality, its freedom from disease germs, &c.

In the matter of manures and fertilizers it is always easy to treat a few plants at a time and watch the effect before making general use of any new fertilizer, cucumbers grow rapidly, and the results are very soon apparent. For instance, if the use of nitrate of potash which I have recommended, is found to give good results in the case of a few plants in one house, its use can easily be extended to all the other plants and houses, if thought desirable, while, by this system, the risk of mistakes is made much smaller.

CHAPTER XXII.

SUMMER CUCUMBERS.

As a general practice I have always grown the summer crops of Cucumbers without fire heat and when the weather has been at all favourable such crops have been the most profitable. At the Redlands Nursery firing is a serious item, most of the boilers have been in use for a number of years, and are very much corroded inside so that they do but half the amount of work they should do. In addition to this the water supplied by the Portsmouth Water Co., is very hard indeed and though I have tried various remedies for the corrosion occasioned thereby I have not yet succeeded to any extent. Again, some of the chimneys are not high enough by half to produce a sufficiently quick draught, such as is often necessary in summer when sun heat is more than sufficient during the day. During my visits to the many nurseries in and near Worthing, I have seen some splendid summer crops grown without fire heat in any way; on other occasions I have visited growers who use fire for cucumbers almost all the year round, but I cannot say that the resulting crops in any way justified the extra outlay on fuel and firing. I have carefully noted, for some years, firing in relation to the cucumber leaf blotch disease, and so far as my experiences have indicated, fire heat will in no way stop or check the disease. I know one grower, in particular, who is firing the whole year through, and for years he has been troubled both with the "blotch" disease and with the mildew very badly indeed.

The one principal drawback with non-heated houses in summer is the lack of warm water for watering purposes, and heavy waterings with cold water are very injurious to the welfare of the cucumber plants. This difficulty I have now overcome to a very great extent, even in those houses where the tanks were too small to hold sufficient water. I keep the greenhouse pipes continually filled with water by means of ball-taps, so that I have always a large quantity of water at hand, sufficiently warm in summer, to be used without lowering the temperature of the beds. I have found an enormous benefit from using these ball-taps for there is no ensuing waste of water and the cistern is kept always filled up, whereby the boiler works better. Keeping the pipes filled with water has the additional advantage during summer that it helps to maintain the temperature of the house during the night, because water does not lose its acquired heat, after sunset, so rapidly as the soil does.

The practice of watering cucumbers with hose pipes is one that requires most careful management, and in general, has much to condemn it. In any case a rose must be used. Employing the open nozzle of the tubing would mean great harm to the plants. It should never be used at all, except on an urgent occasion when its use may be practically unavoidable. I have let my own men employ it, but only when the beds required a thorough good soaking. The water from the main is, in hot summer weather, free from cold and may be used without fear. In fact, I have tested it many times and frequently found that, in the early morning, its temperature was higher than that of the outside air. The great drawback in watering with a hose-pipe connected with the main is the uncertainty of pressure and consequently of the quantity of water supplied in the same period of time on different occasions, so that one cannot set the men to work on the basis of watering each house for a period of so many minutes, etc. Again when watering in this manner, liquid manure cannot be employed, the use of which is the quickest process of feeding the plants, for it is assimilated by them far more quickly than are the top-dressings, and when it is used in a highly diluted form it is of the greatest value to the plants. Remember that an excessive use of it is conducive to increased foliage and to a less amount of fruit. The foliage may suffer, too, from sunburn, for the same reason. A very serious drawback of cucumber growing in unheated houses is the gumming of the fruit and the fruit becomming bitter. Both of these are the result of too low a temperature at night acting upon the circulation of the juices. After a few very cold nights the gumming of the fruit usually follows, but luckily with the return of warmer nights the gumming will entirely disappear.

CHAPTER XXIII.

CUCUMBERS IN CONJUNCTION WITH OTHER CROPS.

As market growers always aim at securing the highest possible return from each of their houses, they have long made it a practice to utilize Cucumber houses for other crops also, when the cucumber plants are in their early stages. Beans are a crop that generally succeed quite well, in this way, either planted or grown in pots. The best beans that I know for forcing purposes, such as I now refer to are "Sutton's Early Forcing," a very dwarf bean with small foliage. "Osborne's Forcing" is a very good cropper, and like the first named has small foliage. "Ne Plus Ultra" is another good forcing bean, semi-dwarf and a heavy cropper, I have also tried Canadian Wonder, but for an inside crop its habit of growth is too luxuriant, under the circumstances. "Zion House" is a bean much recommended for the present purpose, but I have have never tried it.

Speaking generally, I think I can most safely recommend the two varieties I first named, for forcing purposes, they crop continuously for a great length of time if the fresh beans are picked off while still young. The culture of beans is a very simple matter, they require the same temperature, with plenty of light, as the cucumber plant does. The compost prepared for the latter will meet the requirments of the bean equally well, but old soil should never be used for fear of introducing eelworm into the house which would injure the bean and contaminate the cucumber compost too. I use the pots that have held the chrysanthemum plants during the winter, they are well crocked and filled with soil up to within one inch from the top of each pot, thus saving the after labour of top-dressing.

I sow about eight beans in each pot and afterwards reduce the number to five, in each, discarding the weakest plants. For planting out purposes I very rarely sow the seeds direct in the ground, but in small pots, at first, planting them out afterwards. The best results are obtained when the beans are sown at the same time as the cucumber seeds, each being sown in their respective pots, and the beans being planted out (where planting out is adopted) first. This will allow for a full crop of beans with this advantage that the soil will be in a warm condition for planting the cucumber plants.

From four houses, each 100ft. long, I have generally managed to get enough beans to pay for about twenty tons of coal, and when the matter is viewed in this light it is easily seen how paying these joint crops are, with no extra outlay of any kind for the secondary crop except the small matter of the watering. Much depends on the season, beans paid very well indeed in 1903, and to all appearance they will do so again this year. The one great drawback with bean grown in cucumber houses is that the Red Spider (Tetranychus telarius) has a great liking for the leaves and soon goes right through a house, unless speedily checked, as we have already noticed, it is easily carried about on the clothes of a workman, so that the utmost care is necessary. Liquid Manure greatly assists the beans once they begin to bear. The cucumber houses can be used for many similar purposes during the early stages of the main crop, but on no account should greenhouse plants from other houses be introduced into them if we wish to avoid the least possibility of bringing in the cucumber blotch disease.

CHAPTER XXIV.

BOILERS, FIRING, &c.

I have carefully abstained from recommending any particular varieties of cucumbers for the reasons already explained in the preface, and for a similar reason I cannot make special mention of any particular kind of boiler as possessing special merits. But I think this little book would not be complete without some short account of my experiences in the matter of firing in general, because so much of the good results of early crops depends upon the maintenance of a sufficiently high and uniform temperature. Much harm is done by starting the cucumber plants in a temperature that cannot be maintained subsequently; the lowest possible temperature at night, consistent with obtaining good results, is 60°. If the temperature falls before this point for several mornings the soil will become chilled to such an extent that the plants will be ruined. Even if they recover afterwards, such plants never bear fruit for any length of time, and from the financial standpoint they are worthless.

Greenhouse boilers too, ofen fail to give full satisfaction owing to their being set up by inexperienced hands, often by men who have no knowledge at all of the principles underlying their erection. It has always seemed to me that the very first essential of all in cucumber forcing is to have a good well-set boiler and system of pipes, capable of keeping an even uniform temperature at whatever height may be required during all weathers. The stoking is a matter requiring very great attention during the period of cucumber forcing, and far more so than is needed in the case of most crops. For cucumbers I always prefer to use anthracite rather than coke, the former gives off a stronger heat and lasts much longer, so that stoking late at night is not so much needed as in the case of coke, but anthracite can only be used for large boilers. The cost of firing is a very serious item. Four hundred feet houses, all planted with cucumbers, cost me from £40 to £50, for early crops planted in January or February, practically consuming one fourth of the gross receipts.

A very serious mistake in the erection of cucumber houses with heated pipes is to have the pipes too far away from the bed. I have just visited a friend of mine starting in business, some splendid houses are just finished, yet for early cucumber growing they are utterly unsuitable on account of the hot water pipes against the wall being laid on too high from the ground, in some places as much as three feet high. I also found the boiler set with ordinary bricks instead of fire bricks; as much as 10% of heat is absorbed by these soft bricks, and consequently lost entirely

CHAPTER XXV.

GENERAL REMARKS.

I never had the intention, when first I conceived the idea of writing this little book, of spending so much time upon it as I have done, and although so short, it has meant several days of hard work, both for myself and for my manager, Mr. H. Y. Childs, who has taken the utmost pains in preparing this little work for the Press. We both have carefully gone through the books of the nursery in order to ensure perfect accuracy in all the facts relating to records of crops, methods employed in particular cases, &c., so that no pains have been spared in making the book as accurate as it possibly can be; but I will ask my readers to remember that however carefully one may write, it is always possible, at times, for a mistake to be made. My object has been, above all, to give the fullest details of my own personal experience; hundreds of small nurseries depend upon cucumbers as their staple crop and their principal source of profit, and I am convinced that it is by a comparison of various methods as actually employed and of experiments made from year to year that growers can derive most benefit in the long run. Little indeed can be gained by making a secret of the methods employed; I, personally, have derived more useful knowledge from observing and discussing the methods of my friends in the trade, and by inspecting various nurseries, year after year, than I could have gained from my own solitary experiences as a grower, and I hope to have many more such discussions with my friends and colleagues, for it is in this direction, above all others, that progress lies. So far as this book is concerned I am quite open to criticism, I invite it, nothing would please me more than for any readers whose experiences seem to lead them to form different conclusions from mine, to make their facts public, provided such discussion is not anonymous, and I would be still more pleased to visit their nurseries and see for myself whatever they may have to urge, for it is my habitual custom never to pass by advice coming from practical gardeners; I am always glad to put it to the test of experiment before deciding either for or against the particular argument. I am much indebted to Mr. Geo. Massee and to the Rev. W. Wilks, secretary of the Royal Horticultural Society, in allowing me to reprint Mr. Geo. Massee's article "On a method for rendering Cucumber and Tomato Plants immune against fungus parasites." I urge upon my readers to read this most carefully, also the letter which Mr. Massee kindly sent me. Mr. J. Chidlow has kindly written a short paper on cucumbers for a private garden; it appears as an appendix.

As a last word to my readers let me urge upon them the necessity of making themselves at home with the latest facts and knowledge bearing upon the cultivation of their crops, whether cucumbers or any other crops. Without doing so they cannot hope to go on doing better each year than the last, and this should certainly be the ambition of each of us, both in the matter of scientific methods and of financial gain. I, myself, feel I can never fully express how greatly I am indebted to the various papers and articles contained in the Journal of the Royal Horticultural Society, each one written by an expert in his own department, and considering the small outlay incurred by being a Fellow of the Society, and the many valuable privileges attached to the Fellowship, I am convinced that no up-to-date gardener or nurseryman having his own interest at heart will continue to forego all these advantages that I have mentioned.

* * *

March 10th, 1904.

Dear Sir,—If you receive permission from the R.H.S. I shall be pleased to see the paper you refer to published in conjunction with a practical paper such as yours on the subject of cucumber growing. I think you would do well to suggest its trial on a small scale, say one house, as you can readily undersand, that laboratory experiments with a few plants is not the same as on a large scale. Knowing as I do, and as you probably do on a much more extended scale than myself, the slipshod methods of some cultivators as to weighing and measuring; it is most important that the quantities given should not be exceeded to obtain the best results. If more copper is used, stunting takes place; it is possible by using much more than indicated to stunt the plants so that they do not much exceed 2ft. high, and are smothered with bloom, perhaps very ornamental, and even of use in this line, but they don't produce cucumbers.—Yours very truly,

GEO. MASSEE.

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ON A METHOD FOR RENDERING CUCUMBER AND TOMATO PLANTS IMMUNE AGAINST FUNGUS PARASITES.

By George Massee, V.M.H.

The amount of forcing in the way of high temperature, excess of moisture and constant application of fertilisers considered necessary to secure a fair margin of profit, when Cucumbers and Tomatoes are grown in a wholesale manner under glass, renders plants thus treated highly susceptible to disease.

There are two principal reasons for this susceptibility: (1) "soft" foliage; (2) the presence of fungi and eelworms in the soil.

It is a well-known fact that, in the case of plants growing in the open air, infection by fungus spores occurs almost entirely during the night, when the vital activity of the foliage is somewhat checked, due to retarded transpiration and respiration. Under these circumstances there is an accumulation of those substances favouring infection present in the leaves. This is what constitutes "soft" foliage. During the day the vital activity of the leaves is unimpeded, and the various substances formed are quickly conveyed away to other parts of the plant; hence the facility for inoculation by fungus spores does not exist. This is the condition expressed by the term "hard" foliage.

In the case of plants growing under glass as described above, the conditions are practically always highly favourable for the production of "soft" foliage; hence their extreme susceptibility to infection from fungus spores This condition of things explains the rapidity with which an epidemic spreads when it once gains a foothold; whereas plants of the same kind grown out of doors, or even under glass, under more normal conditions remain free from disease.

Under the exceptional conditions of cultivation described above, not only do the well-known parasites of the Tomato *Cladosporium fulvum*, Cooke, and *Fusarium lycopersici*, Sacc.) and of the Cucumber (*Cercospora melonis*, Cooke) flourish luxuriantly, but certain other fungi, normally occurring only on decaying vegetable substances, in the open, now and again assume a parasitic existence, when accidentally introduced into houses where the conditions are so favourable to their development.

The case of *Dendryphium comosum*, Wallr , may be given as an illustration. This minute fungus is not uncommon in Britain and other countries. It grows on decaying plants, which it frequently covers with a dense dull olive-coloured mould.

During the present season a market-gardener, whose Cucumbers suffered severely from leaf-blotch (*Cercospora melonis*, Cooke) last year, brought a number of diseased Cucumber plants to Kew for examination. The general aspect of the plants suggested a recurrence of the epidemic of the previous season; but microscopic examination and repeated cultures and inoculations showed the blotches on the leaves to be caused by *Dendryphium comosum*, Wallr. Further investigation showed the fragments of manure projecting from the soil in which the plants were growing to be covered with a copious development of *Dendryphinm*, and the fungus was finally traced to the manure heap.

Previous to the present record, *Dendryphium* has never been known to act as a destructive parasite; and its becoming so in the present instauce is entirely due to its accidental introduction, along with the manure, to a set of conditions which enabled it to assume a parasitic existence on plants predisposed to disease. Experiments conducted at Kew prove conclusively that *Dendryphium* cannot attack Cucumber plants growing in a cool frame. It may be added that the *Dendryphium* has not only spread throughout the house where it originated, but has also attacked Cucumbers in two other nurseries owned by the same gardener, the spores having heen carried by clothing, tools, &c., from one place to another.

No records of the occurrence of this newly-created parasite are as yet to hand from other localities than those enumerated, but now that its parasitism is established, it is likely to extend its area of devastation.

The use of fungicides in the form of sprays has not by any means produced the results desired and anticipated, and extended experiments have demonstrated that, under the conditions necessary for the rapid production of Cucumbers, the daily syringing and constantly damp surface of the foliage render useless those fungicides which, when applied under more favourable conditions, have proved effective. Under the circumstances, a series of experiments have been carried out with the object of ascertaining whether some substance taken up by the roots of Cucumbers and Tomatoes would not render plants thus treated immune against the attacks of fungus parasites, without at the same time exercising any injurious or retarding effect on growth or on the production of fruit.

From among the various substances tested, sulphate of copper ($CuSO_4$) alone met all the above-mentioned requirements. The following is an outline of the mode of treatment of plants rendered immune by the use of sulphate of copper.

The Cucumber and Tomato seed was sown, and the plants grown throughout in a stove having a mean temperature of 75° F., the humidity varying between 79° and saturation point. The potting, watering, spraying, and general treatment were left entirely to a gardener, and consequently was conducted along the lines followed in establishments where the fruit is grown for sale.

The Cucumbers were of the varieties known as 'Telegraph' and 'Every Day,' and the Tomatoes 'Up to Date' and 'Main Crop.' Three hundred Cucumber seedlings and an equal number of Tomato seedlings were subjected to experiment, fifty of each kind being used as check plants. When the seedlings were a fortnight old, the Cucumbers were grouped round eight large Cucumber plants badly attacked by *Cercospora melonis*, Cke., and *Dendryphium comosum*, Wallr., and the Tomato seedlings were arranged around a Tomato plant bearing numerous blotches on the leaves caused by *Cladosporium fulvum*, Cke. At this period the specific course of treatment commenced, which consisted in watering the plants every third day with a solution consisting of one part of sulphate of copper in seven thousand parts of water. The check plants, which were not watered with the copper solution, were indiscriminately mixed with the treated plants. The watering was done during the afternoon, and the quantity used for each plant was sufficient to soak the soil thoroughly.

After a month's treatment all the Tomato plants were perfectly free from disease. On the other hand, one or both cotyledons of thirty-four Cucumber plants showed blotches of the disease. At the same time a considerable number of the untreated check plants, both Cucumbers and Tomatoes, were badly diseased.

At this stage, both treated plants and checks were sprayed with water containing the spores causing their respective diseases, and this was continued weekly until the end of the experiments. Under this drastic treatment all the untreated check plants, both Cucumbers and Tomatoes, were badly diseased during the following two weeks.

After six weeks' treatment with the solution of sulphate of copper of the strength indicated above, the strength was increased to one part of sulphate of copper in six thousand parts of water, and the soil in which the plants were growing was soaked every fourth day until the end of the experiments, which lasted for eleven weeks. At the expiration of this period both Cucumber and Tomato plants were bearing a good crop of well grown mature fruit.

Not a single one of the Tomato plants treated with the sulphate of copper solution showed a trace of disease; and in the case of the treated Cucumber plants, the disease never extended beyond the cotyledons, and this notwithstanding the fact that badly diseased plants were growing amongst the treated plants throughout the entire period. In addition to this, the treated plants were sprayed several times with water containing spores of the fungus parasites in suspension. It now simply remained to ascertain whether any of the copper taken up by the roots of the plants had been deposited in the fruit. For this purpose specimens of Tomatoes and Cucumbers borne by treated plants were submitted to Dr. Thorpe, C.B., F.R.S., Principal Chemist, Government Laboratory, who reported as follows:

"I have examined the samples of Tomato and Cucumber produced from the plants treated with solutions of copper sulphate sent to me on the 4th instant, but there is no evidence that the amounts of copper present are sensibly greater than are found in the fruits obtained from the untreated plants.—(Signed) T. E. THORPE."

It is important to bear in mind the fact that the above method of treatment for producing immunity against fungus parasites applies to Cucumbers and Tomatoes only, so far as direct experiments have been carried out. A solution of sulphate of copper appears to have markedly different effects on different kinds of plants. *Luffa ægyptiaca*, Mill., a close ally of the Cucumber, is killed by two waterings at a strength of one in six thousand. Barley, on the other hand, remains perfectly healthy when treated with one in five hundred, and in addition may become badly attacked by its common parasite, *Oidium graminis*, P.

The proof that the solution of sulphate of copper is actually absorbed by plants is well shown in the garden Nasturtium, *Tropæolum Major*, L., where the effect of too strong a solution is first indicated by a bleaching of the tissue surrounding the water stomata, situated at the margin of the leaf. When Grasses are similarly treated, the tip of the leaf, where the water-stoma or its equivalent crack in the epidermis is present, is the first part to bleach and die.

In what particular way sulphate of copper is capable of rendering certain plants immune against the parasitic fungi is not definitely known, neither is this the place to discuss in detail this phase of the subject. It is certainly not due to the solution present in the leaves killing the germ-tubes of the spores on their entry through stomata, because spores of all three species of parasites alluded to in this paper germinate readily in a solution of one in seven thousand of this substance. The probability is that the copper arrests or modifies the production of some substance in the leaves, which favours the entry of the fungus into the plant.

Danger arising from the presence of fungi or eelworms in the soil can be guarded against by sterilising the soil yearly with gas-lime. It is equally important to treat in this manner fresh soil, about to be placed in the houses, as that already there.

PRACTICAL DIRECTIONS FOR TREATMENT.

Commence watering Cucumbers and Tomatoes when a fortnight old, every third day with a solution consisting of one ounce of sulphate of copper dissolved in 50 gallons of water. After treating for six weeks as above, commence watering every fourth day with a solution containing one ounce of sulphate of copper in 35 gallons of water.

The sulphate of copper should be pure, and rain water should be used if possible.

◆

APPENDIX

By J. CHIDLOW.

I have been asked by Mr. Fabius to add a few remarks as a grower of cucumbers for a private garden, but after perusing what I cannot but regard as his very able and practical remarks on growing cucumbers for market, I fear the reader will think he has left me very little to say.

The general treatment is much the same in each case, with one great exception, that the private gardener is very much more handicapped than the wholesale grower, inasmuch as he cannot devote a house entirely to the growing of one particular subject. But I will show that it is possible to grow cucumbers in a house occupied by other plants. In such a house the cucumbers must be subservient to the other occupants. One generally sees cucumbers grown without any air being admitted, and with a very humid atmosphere, which would be impossible in this case. I will assume that the gardener would like (as in some cases it is necessary) to have them ready by Easter, when they begin to be much appreciated at the table. A start should be made by sowing the seed singly in small 60 pots at the end of December or begininng of January, according to the date on which Easter falls. At this period of the year it is necessary to keep them near the glass to prevent them from becoming drawn and attenuated. When the pots are filled with roots, they should be shifted on into 48 pots, using a compost of turfy loam, leaf mould, and a liberal sprinkling of sharp sand, still keeping them close to the glass in a temperature of not less than 60 or 65 degrees, higher if the heat can be maintained, carefully avoiding anything like sudden or great changes of temperature. In the meantime, have the trellis stages, etc. well cleaned, and the mould in which they are to grow brought in for it to get thoroughly warm by the time the plants are ready for planting, which, if they have been kept growing will be about the first or second week in February. Use a compost of two parts turfy loam chopped up, one part leaf mould, and one part burnt mould, and a little grit may be added to insure porosity. When planting, see that the plants are in a moist condition, so as not to require water for a little time after planting has been done. Dew them over with the syringe twice a day when the weather is bright, for as they grow they will require great attention in watering. Above all, avoid getting the soil into a saturated condition, as this makes them prone to flag, especially after dull weather.

When the plants have reached the first or second wire of the trellis, they should have their points pinched out and as they break, be carefully *tied* down and pinched after the fruit is formed, at the second joint beyond. As regards insect pests, Mr. Fabius has dealt quite fully with that subject, and any remarks of mine would be superfluous. With regard to growing cucumbers with plenty of air and no shading, I have had ample opportunity of watching Mr. Fabius's experiments, and I can say that his success in growing under these conditions leaves nothing to be desired. The foliage of the plants was stout, and the plants themselves short jointed. No trace of the dreaded disease was to be seen, and the crop of beautifully coloured, well shaped, short-necked fruit was an object lesson not easily forgotten. How much pleasanter it is for men to work under such conditions than in a house where no air is admitted. During the warm summer nights I have seen the ventilators open at 7 and 8 o'clock p.m., but this is regulated of course by the state of the weather. It has always seemed to me that there must be something wrong with the system of cultivation when the plants require to be shaded. I would advise anyone who has always grown cucumbers in a very close atmosphere with no air admitted and the glass heavily shaded, to try one house under the conditions above named and in the summer months.

Of course, as I said before, in a private garden there are other occupants of the house to be thought of, and it would not be wise in the case of very early cucumbers to admit cold draughts of air, as in the early months of the year the temperature must be kept up. I may mention, in the course of my remarks, that cucumbers are not the only crop that Mr. Fabius makes a speciality of. He grows large quantities of tomatoes, etc. The tomato plants are at the present time, February 28th, all stiff and sturdy, and showing large trusses of bloom, and there is every prospect of a good harvest later on. I can honestly say that they prove him to be a past master in tomato growing. A large quantity of strawberries in pots are being grown at Redlands, 10,000 or more, they are all Royal Sovereign, to which variety Mr. Fabius pins his faith. To look through the tomato houses, where the plants are suspended and covered with spikes thrown well up and covered with handsome snowy blossoms, is an effect worth going a long way to see. A floral business is also being worked up with the interest and energy Mr. Fabius always puts into his work. Innumerable bedding plants of all kinds, far too numerous to mention, are grown at the nursery, where a few hours passed in the genial companionship of Mr. Fabius is an experience gained.

INDEX.

Acids, 25
Aeration of Soil, 11
Age of Seeds, 36
Airing Houses, 19
Ammonia, 10, 12
Anthracite, 46
Aphis, 22, 30
Artificial Manures, 24

Ball-Taps, 42
Basic Slag, 11
Beans in Cucumber Houses, 44
Beds, 13
Benches, 27
Bitter Cucumbers, 24
Boilers, 46
Bordeaux Mixture, 22
Bottom Heat, 8
Bones, 6, 14
Bracken, 11
Burnt Refuse, 11

Carbolic Acid, 27
Carbonate of Potash, 11, 23
Chanking, 21, 39
Checks, 20
Chimneys, 42
Cleaning Houses, 27
Clinkers, 13
Club, 6, 7, 9, 10, 14, 26, 27
Coke, 46
Compost, 5, 9
Continuous Crops, 13
Corrosive Sublimate, 36, 37
Cost of Firing, 46
Cow Manure, 11
Cropping, 40
Cucumbers:—
    Beds for, 13
    Early, 8
    For a Private Garden, 52
    In old Houses, 10
    Requirements of, 8
    Soil for, 9
    Stunting of, 8
    Winter, 8
Cucumber Houses, 5, 6
Cutting the Fruit, 39

Damping Down, 22, 28
Dirty Glass, 18
Disposing of Cucumbers, 31

Eel-worms, 10, 12
Express System, 31

Fertility of Soil, 11
Fertilizers 9, 12, 34, 41
Fire-bricks, 46
Fire Heat, 42
Firing, 46
Flagging, 18
Foliage, 9, 22, 43
Fruit Curling, 19
Fumigating, 15, 22, 30, 32

Gas Lime, 10, 27
Gishurst Compound, 28
Greenfly, 1, 15, 26
Gumming of the Fruit, 43

Harvesting Seed, 37
Horse Manure, 11
Hose Pipe for Watering, 43
Hot Beds, 14
Houses, 33

Ideal Soil, 11
Insect Pests, 26

Keeping Pipe filled, 42

Large Beds, 33
Leaf Blotch Disease, 22, 26, 28, 29, 42, 45, 49, 50, 51
Lime, 11, 12, 24, 27
Liquid Insecticide, 30
Liquid Manure Water, 13, 22, 25, 40, 43, 45
Manure, 9, 11, 14, 34, 41
Mechanical Conditions of the Soil, 10, 11
Mice, 7, 34
Mildew, 29, 32
Minerals, 25

Nematodes, 6, 36
Nicotine Compound, 28, 30
Nitrate of Ammonia, 25
Nitrate of Potash, 25, 41
Nitrogen, 25
Non-heated Houses, 42

Old Cucumber Soil, 9
Old Houses, 30

Old Seed, 38
Outdoor Cucumbers, 36

Pipes, 46
Planting out, 7, 13, 15
Plants not Breaking, 40
Pollination, 34
Pots, 5, 7, 14, 31

Rats, 7, 34
Red Spider, 6, 15, 22, 28, 45
Re-planting, 31
Re-potting, 7
Roots, 15, 20, 23, 33

Sand, 11
Seed, 34, 35, 36, 37
Seed Cucumbers, 34, 35
Setting of Fruit, 34
Shaded Houses, 17
Shading, 17
Shoots, 16, 39
Side Shoots, 16
Smoking the Houses, 6, 32
Sods, 13
Soil, 9, 10, 11, 13, 22, 40
Soot, 25
Sowing the Seed, 5
Staging, 8, 14
Sterilization, 10, 36, 37
Stopping, 16
Staking, 46
Storing, 35
Straw Litter, 13
Steaming the Pipes, 22
Sulphur, 5, 28, 32
Sulphur, Vaporising. 32
Summer Cucumbers, 42
Sunburn, 43

Superphosphate, 40
Syringing, 22

Temperature, 7, 19, 20, 22, 29, 30,
32, 33, 43, 46
Thinning the Fruit and Shoots, 39
Thrips, 6, 15, 22, 28
Top-dressing, 11, 13, 23, 26, 40
Training, 16
Treatment of Seeds, 5, 67
Trenches, 11
Troughs, 8, 27
Tying, 16

Vaporising, 28, 30, 32
Ventilation, 19
Water, 25, 42
Watering, 7, 15, 19, 20, 42, 43
Weeds, 10
Width of Beds, 13
Wireworm, 27
Woodlouse, 27

Young Plants, 6

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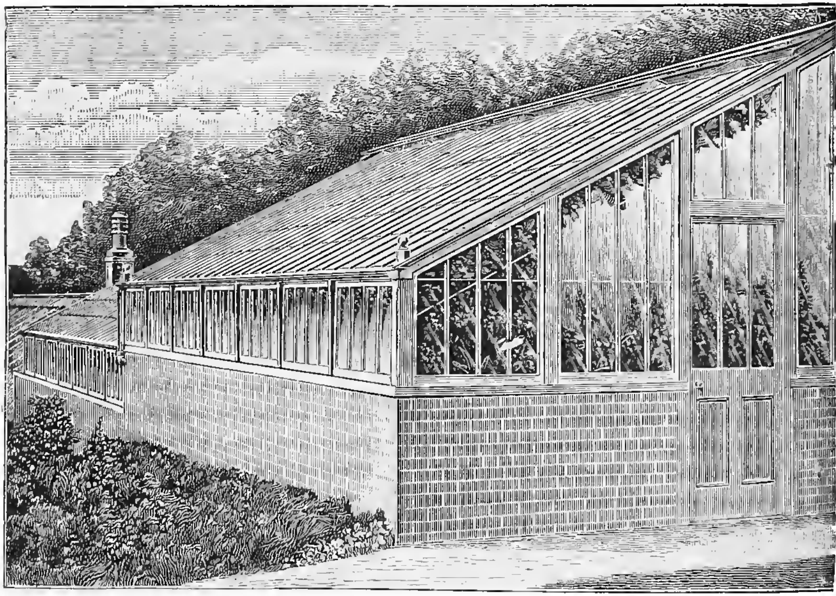

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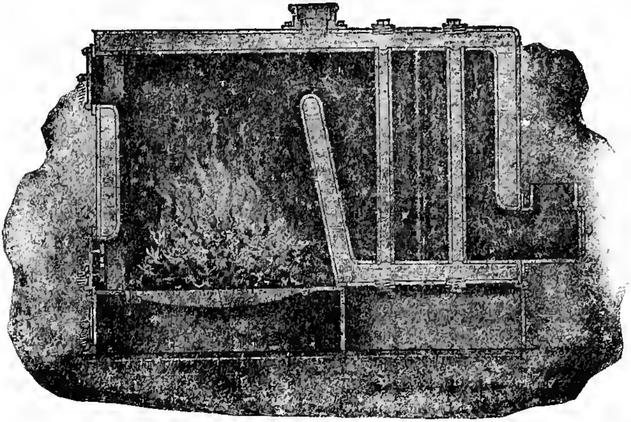

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